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TI - THERMOSTATIC HOLDER AND OPTICAL DEVICE USING THE SAME

IN - IMAIZUMI HISAAKI

PA - KOMATSU MFG CO LTD

IC - G02B7/00 ; F28D15/02 ; G02F1/37 ; H01S3/10

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TI - Constant temp. holder for optical appts. - includes temp. controller to keep constant temp. of target object positioned inside hollow **heat pipe**

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AB - J08220406 The holder is made of a rectangular hollow heat pipe (1) in which a temp. controller (2) is thermally connected on its external.

- The temp. controller is included so that the constant temp. of a target object (6) positioned inside the hollow **heat pipe** is held.
- ADVANTAGE - Improves response of held constant temp. of target object. since there is no temp. slope. Obtains very stable output without using optical-cavity support of low line expansion coefft., e.g. bar alloy.
- (Dwg. 1/6)

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IN - IMAIZUMI HISAAKI

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TI - THERMOSTATIC HOLDER AND OPTICAL DEVICE USING THE SAME

AB - PURPOSE: To obtain an optical device which has a good temp. characteristic and a thermostatic holder which has no temp. gradient and has high responsiveness by containing a hollow **heat pipe** and temp. control means and thermostatically holding an object in the hollow part of the hollow **heat pipe**.

- CONSTITUTION: This thermostatic holder is composed of the square hollow heat pipe1, a Peltier element 2 disposed to come into thermal contact with the rear surface of this pipe, a nonlinear optical element 3 fixed into the hollow **heat pipe** 1 in such a manner that the axial center of the hollow **heat pipe** aligns to the optical axis, the nonlinear optical element3 fixed in the hollow **heat pipe** 1, a temp. sensor4 mounted at the end edge of the hollow **heat pipe** 1 and a temp. controller5 for controlling the supply current to the Peltier element2 according to the output of this temp. sensor4. The holder is constituted to emit light along the axial center of the hollow **heat pipe** 1 by maintaining the temp. of the nonlinear optical element 3 at a set temp. Then, the holder is maintained at a desired temp. at a high speed and since the temp. is uniform without temp. gradient, the constant temp. is maintained with high accuracy and the stable output is obtd.

I - G02B7/00 ;F28D15/02 ;G02F1/37 ;H01S3/10

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention -- constant temperature -- an electrode holder and the optical equipment using this -- starting -- especially -- the constant temperature of an optical element -- it is related with a control structure.

[0002]

[Description of the Prior Art] in the optical element using the nonlinear optical crystal with which properties differ greatly, constant temperature is always maintainable with temperature for stabilization of a property -- as -- various methods -- constant temperature -- control is made.

[0003] For example, as shown in drawing 5, in order to make regularity the refractive index of an SHG (second harmonic generation) crystal, Peltier device 133 is arranged in the bottom of the SHG crystal 125. Moreover, also with the laser diode 113 used as the light source, it is made to perform temperature control by Peltier device 131 from the bottom (JP,4-316386,A). As for a fundamental wave and 117, 127 is [a mode MACHIKKU lens and 129] the 2nd higher harmonic, and 137,139 is a spherical wave. By this method, since it has constant-temperature-ized only from the inferior surface of tongue of a crystal, a temperature gradient will be made in the thickness direction of a crystal. Moreover, in the case of a mode dispersion mold or a false phase matching mold (QPM), even in the temperature gradient of about 10 - 3 degrees C, an SHG crystal becomes a problem. Moreover, as for a niobic acid potassium (KNbO₃) etc., also in the case of the bulk crystal of the rate method of a birefringence, precise temperature control with the as large temperature change of a refractive index as $1 \times 10^{-4}/\text{degree C}$ is needed. When a crystal is cooled from the whole surface also in this case, there is a flume problem which a temperature gradient is made and cannot take phase matching.

[0004] moreover, a nonlinear optical crystal -- the cel of a cylindrical shape -- surrounding -- the inside of a cel side wall -- constant temperature -- the method of pouring water and forming a crystal into soak constant temperature is also proposed (JP,60-59225,U). although there is no problem of a temperature gradient not much since it has constant-temperature-ized so that an object may be surrounded with this structure -- constant temperature -- the equipment of water is required and a miniaturization is difficult. Moreover, there is also a problem that the start takes time amount.

[0005] As shown in drawing 6 further again, a hole is made in the center of the disc-like holder 103, sheet metal-like a nonlinear optical crystal 102 and a solid-state-laser medium are embedded, and the structure which arranges Peltier device 104 with a hole in the base of a disk, and was made to perform temperature control is also proposed (JP,5-41557,A). 101 is a laser beam and 105 is a heat sink with a hole. Since the holder has surrounded the object with this structure, although it is good as a sheet metal-like crystal, with the long thing and the bulk of an optical path, a temperature gradient becomes a problem. Moreover, since the heat capacity of an electrode holder is large, there is also a problem that it is restricted to a speed of response.

[0006]

[Problem(s) to be Solved by the Invention] Thus, in the conventional method, there is a problem that a temperature gradient will all be made in the thickness direction of a crystal, or a problem that the responsibility of temperature control is not enough.

[0007] this invention was made in view of said actual condition, and its temperature characteristic is

good and uses it for reliable optical equipment and this reliable -- having -- a temperature gradient -- there is nothing -- the high constant temperature of responsibility -- it aims at offering an electrode holder.

[0008]

[Means for Solving the Problem] then, the 1st constant temperature of this invention -- an object which the feature of an electrode holder is made to contact thermally an outside of a hollow heat pipe and said hollow heat pipe, possesses a temperature control means to perform heating or cooling, and is arranged in a centrum of said hollow heat pipe -- constant temperature -- it is in having constituted so that it might hold.

[0009] the 2nd constant temperature of this invention -- an object which the feature of an electrode holder is made to contact thermally an end side of a hollow heat pipe and said hollow heat pipe, possesses a Peltier device possessing a hole centering on a point on a shaft of an object installed in said hollow heat pipe, and is arranged in a centrum of said hollow heat pipe -- constant temperature -- it is in having constituted so that it might hold.

[0010] The feature of the 3rd optical equipment of this invention is to have provided a hollow heat pipe, an optical element arranged in a centrum of said hollow heat pipe, and a temperature control means for it to have been made to contact an outside of said hollow heat pipe thermally, and to perform heating or cooling.

[0011] The feature of the 4th optical equipment of this invention is to have provided a hollow heat pipe, an optical element arranged in a centrum of said hollow heat pipe, and a Peltier device which was made to contact an end side of said hollow heat pipe thermally, and possesses a hole centering on a point on an optical axis of said optical element.

[0012]

[Function] a heat pipe -- thermal conductivity -- very -- high -- further -- the centrum -- constant temperature -- since the object which should be held is arranged -- the temperature gradient of the thickness direction of a crystal material, and the length direction -- there is nothing -- very -- responsibility -- good -- an object -- constant temperature -- it becomes possible to hold.

[0013] According to the 2nd of this invention, you are made to contact the end side of a hollow heat pipe thermally, and since the Peltier device possessing the hole centering on the point on the optical axis of said optical element is provided, it becomes possible to perform temperature control still more efficiently.

[0014] It becomes possible to offer optical equipment with the very good temperature characteristic, without according to the 3rd of this invention, and the 4th, a location gap arising further again, even if it fixes to this, using this hollow heat pipe as a base material of an optical element and an optical resonator since there is no telescopic motion of the hollow heat pipe by disturbance heat.

[0015] [Example] Next, it explains to details, referring to a drawing about the example of this invention.

[0016] As this optical equipment is shown in drawing 1, the outer diameter of 8mm, the bore of 3.6mm, and the hollow heat pipe 1 of a square shape with a length of 30mm, Peltier device 2 arranged in this inferior surface of tongue so that heat contact might be carried out, and the nonlinear optical element 3 fixed in this hollow heat pipe 1 so that the axis of this hollow heat pipe might be in agreement with an optical axis. It consists of a temperature sensor 4 attached for the edge section of the hollow heat pipe 1, and a temperature controller 5 which controls the supply current to said Peltier device 2 according to the output of this temperature sensor 4. It is characterized by having maintained the temperature of said nonlinear optical element 3 to the set point, having accompanied the axis of the hollow heat pipe 1, and being constituted so that light may be injected. Thermal resistance was 0.026 here, using the heat pipe for power semiconductor cooling of Mitsubishi Cable Industries as a hollow heat pipe 1. This nonlinear optical element can be maintained now from -30 to 100 degrees C to a desired value by control of the direction of said current, and control of supply current.

[0017] According to this configuration, when maintainable [to a desired temperature] at high speed, there is also no temperature gradient, since it is uniform, it can constant-temperature-ize to high degree of accuracy, and a stable output can be obtained.

[0018] In addition, although the square shape heat pipe was used in said example, it cannot be

overemphasized that a circular heat pipe is sufficient.

[0019] A non-linear optical material optical element is attached free [attachment and detachment], without fixing. Moreover, the hollow heat pipe 1 of a square shape, Peltier device 2 arranged in this inferior surface of tongue so that heat contact might be carried out, and the temperature sensor 4 attached for the edge section of the hollow heat pipe 1, the constant temperature which consists of temperature controllers 5 which control the supply current to said Peltier device 2 according to the output of this temperature sensor 4 -- the constant temperature of the various objects as a holder -- it cannot be overemphasized that it can apply to maintenance.

[0020] further -- again -- a nonlinear optical element -- a non-linear optical material (NLO) -- good -- it can carry out and the laser cavity of semiconductor laser, laser data medium, such as Nd:YAG, a non-linear optical material, and a harmonic generation etc. can apply only a non-linear optical material, semiconductor laser, and semiconductor laser to other optical elements.

[0021] Furthermore, although the Peltier device was used as a heating cooling means in said example, a heater, a refrigerator, etc. may be used, without being limited to a Peltier device. Moreover, you may make it attach this Peltier device for a hollow heat pipe free [attachment and detachment].

[0022] Moreover, as a temperature sensor, a thermistor, platinum resistance, a thermocouple, etc. are employable suitably.

[0023] Next, the 2nd example of this invention is explained.

[0024] The heater 12 at which this optical equipment was wound around the cylinder-like hollow heat pipe 11 and this periphery, The nonlinear material crystal 13 fixed in this hollow heat pipe 11 so that the axis of this hollow heat pipe 11 might be in agreement with an optical axis, The temperature sensor 14 attached for the edge section of the hollow heat pipe 11, It consists of temperature controllers 15 which control the supply current to said heater 12 according to the output of this temperature sensor 14. It is characterized by having maintained the temperature of said nonlinear optical crystal 13 to the set point, having accompanied the axis of the hollow heat pipe 1, and being constituted so that light may be injected from said nonlinear optical crystal 13.

[0025] Responsibility becomes possible [obtaining a good and stable optical output] with this optical equipment as well as said 1st example.

[0026] Next, the 3rd example of this invention is explained.

[0027] This optical equipment comes to provide a hole whose axial center and center of the cylinder-like hollow heat pipe 21 and a hollow heat pipe correspond. The heating cooling means 22 which becomes the both-ends side of this hollow heat pipe 21 from the disc-like Peltier device which carries out heat contact, The optical system 23 which consists of semiconductor laser 23a and lens 23b which were fixed in this hollow heat pipe 21 so that the axis of this hollow heat pipe 21 might be in agreement with an optical axis, and SHG crystal 23c, The temperature sensor 24 attached for a part of peripheral surface of the hollow heat pipe 21, It consists of temperature controllers 25 which control the supply current to said heating cooling means 22 according to the output of this temperature sensor 24. It is characterized by having maintained the temperature of said optical system 23 to the set point, having accompanied the axis of the hollow heat pipe 21, and being constituted so that light may be injected from said optical system 23.

[0028] In addition, the heating cooling means 22 which consists of this Peltier device consists of heat exchange substrates 22a and 22b which consist of a doughnut-like alumina ceramic, and pn element pair 22c pinched through the electrode (not shown) arranged regularly among these, as an important section enlarged view is shown in drawing 4.

[0029] Responsibility becomes possible [obtaining a good and stable optical output] with this optical equipment as well as said 1st example.

[0030] In addition, although the Peltier device was arranged in the both-ends side of a hollow heat pipe in said example, only one field is.

[0031]

[Effect of the Invention] the constant temperature of this invention -- according to an electrode holder -- a temperature gradient -- there is nothing -- very -- responsibility -- good -- an object -- constant temperature -- it becomes possible to hold.

[0032] Moreover, according to the optical equipment of this invention, it becomes possible to obtain

a very stable output, without using the optical-resonator base material of low coefficients of linear expansion, such as the Invar alloy.

[Translation done.]